



Original communication

B-learning training in the certification of causes of death



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ABSTRACT

Introduction: An adequate certification of causes of death is essential for Public Health. The objective of this work is to improve the professional competence of medicine students and family doctors with regard to the certification of causes of death according to the international regulations of the WHO.

Methods: Intervention-formation, before and after design, addressed to students of Medicine in their last year (6th year), and Family Doctors and Interns. The blended learning or *b-learning* program consisted in an on-site seminar-workshop, plus basic information/documentation stored in an on-line platform, together with the preparation of Certificates of Causes of Death based on Clinical Histories of real cases.

Results: 308 students participated in the program. We observed an individual improvement in the professional competence in all certifications of death, which was significant in 3 out of 5 cases (it was not significant in a medical-legal case of violent death and the case of a pluripathological chronic patient). The *intermediate causes* improved in all cases. Most formal aspects of the certification improved with significant changes. In the group of 62 Family Doctors and interns who took part in the program there were improvements in the *basic* or *underlying causes* in 4 of the 5 cases and improvements in the formal quality of the assessment, although less significantly than in students, because they started with better basal indexes in their certificates in the *Before* stage of the study.

Conclusions: Blended learning training has shown to be effective in improving the professional competence, both in students of the Degree of Medicine and in practicing Family Doctors and Interns.

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1. Introduction

Mortality statistics are still an essential index to establish health priorities based on the lethal effect of diseases. From the point of view of Public Health, mortality statistics make it possible to take decisions on Health Planning and to draw international comparisons on mortality levels and rates. All this is only possible if the proper documents are completed according to the rules established by the World Health Organization (WHO).¹

There has recently been a change in the certification of causes of death in Spain, where the Statistical Report of Death (SRD) and the Death Certificate (DC) have been combined into a single document to register causes of death in this country, thanks to an agreement between the Spanish National Institute of Statistics (NIS) and the

Spanish Organization of Professional Medical Associations (OPMA), with the approval of the Spanish Ministries of Health and Justice.²

This new certification model was first used in Spain on the 1st of January 2009; but after one year in use, a common error was detected in the section on the *logical sequence* between the *underlying* cause and the *immediate* causes. That is, in the section of the *preceding* causes. Practitioners who filled in the certificate considered that this section should include the clinical record, instead of detailing the pathological or morbid processes that are the consequence of the *basic*, *initial* or *underlying* cause. For this reason, the name of this section was changed to *intermediate causes*, and the Medical Associations were asked to carry out informative and/or formative activities as part of their Continuing Training programs.

Our study can be classified within this professional context.³ Formation in the Faculties of Medicine related to death certificates is an activity that has been carried out for years,⁴ and which is reaffirmed based on the formative priorities created by a panel of experts with the Delphi method.⁵ In this process there are two participating areas of knowledge and professional competence: the

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Area of Preventive Medicine and Public Health, due to their interest and concern on the reliability, validity and use of the health indexes of the Health Information System⁶; and the Area of Legal Medicine, due to the medical-legal aspects associated to death as a social and health-related event.

Mortality rate statistics are still highly important due to the creation of new research indexes, such as *amenable mortality revisited*, which was proposed by the European Union to assess the attention of health systems.⁷ Also, the constant improvement in the quality of mortality rates still has a great legal significance.⁸

On-site medical training has proven effective, and its implementation is justified in the syllabus of the Degree in Medicine; but also in the Continuing Professional Development programs of medical practitioners,^{9–11} which include Information and Communications Technology (ICT).

The objective of this blended learning formative intervention was to improve professional competence in the certification of causes of death by students of Medicine, practicing Family Doctors and Interns in the Spanish National Health System.

2. Methods

To achieve these objectives we carried out a *quasi-experimental* intervention study with a *before and after* design without a control group.¹² We are aware that the presence of a control group improves the scientific rigor of the study, but it was not used because the classic formative intervention has proven to be effective, and it would therefore be unethical to deprive a group of students of Medicine and/or doctors of this model. The intervention consisted in an informative activity on the epidemiological and medical and legal importance of death certificates, and a formative activity to get 308 students from the last year of Medicine (the 6th year in Spain) and 62 practicing Family Doctors and Interns to improve their professional competence with regard to the certification of causes of death, so that they are able to issue quality certifications which are reliable and valid according to the International Standards of Certification of the WHO.^{1,13}

First of all, the certificates from 12 cases were filled out. The selection of these cases was on clinical records according to the frequency of appearance and taking into account the medical-legal errors that were observed and that had been analyzed *before* the beginning of the training activity, that is, without an intervention (*Before*). Afterwards, there was a formative intervention that included a five-hour on-site seminar-workshop with two parts, one of them on the theoretical bases and medical and legal aspects of certification. Subsequently, a practical part was carried out, in which the certificates of 12 cases on death causes based on a short Clinical History that were presented via *PowerPoint* were filled out. From these cases, 5 were randomly selected for their study and research.

The workshop was taught by two lecturers from the Faculty of Medicine of the University of Salamanca, an epidemiologist and a forensic scientist, both of them with professional and teaching experience on this subject. Also, the on-line platform *Studium* was available for the student to revise and develop the knowledge and fundamentals presented in the seminar.

Finally, after four weeks of virtual training with the cases, a date was set in which the groups who had taken part in the intervention filled out the certificates of 5 cases that were randomly selected from the initial 12 cases (*After*). A survey also recorded the satisfaction with the workshop and the teaching-learning process with the introduction of ICTs.

In order to collect and process the information, we established a series of *Major Quality Indexes* related to the causes of death (either *underlying*, *intermediate* or *immediate*), and *Minor Quality Indexes*

related to formal aspects based on previous experiences,¹⁴ on the certification standards of the WHO¹ and on the articles by other authors.^{9,15}

The software program *SPSS version 21* was used in the analysis of data, which was carried out by two researchers different to those who dealt with the formative intervention. That is, researchers were *blinded* while processing and obtaining the results.

The statistical analysis included a descriptive study of the distribution of absolute and relative frequencies (proportion) (*univariate analysis*), with the calculation of their respective 95% confidence interval (CI) for a proportion; afterwards, we carried out an association study (*bivariate analysis*), with *Pearson's chi-squared test* to assess the strength of the association between qualitative variables. The assumed level of statistical significance (error) was 5% (significance level $p < 0.05$).

3. Results

The intervention was carried out with a total of 308 students in their sixth year of Medicine in the past two academic years, 2011–12 and 2012–13. The observations on the 5 death certificates that were proposed by the students are presented in Table 1. As can be seen, the intervention significantly improves the assessment of the *underlying cause* in 3 out of the 5 cases. The *underlying and intermediate causes* improve in all 5 cases, and the *immediate cause* shows good reliability both *before* and *after* the intervention. That is to say, the *Major Quality Indexes* related to the certification of causes of death improve. Table 2 shows the *Minor Quality Indexes* or *formal quality criteria* associated to the certification based on international norms. The intervention reduces the use of inappropriate and imprecise terms and also the confusion between mechanisms and causes of death. The decreased use of abbreviations also improves significantly, as does the use of capital letters in most proposed cases, which improves the legibility and understandability of the certificates.

With regard to the continuing training intervention in 62 Family Doctors and Interns who voluntarily decided to participate, they also filled in 5 certifications on the same cases as the students. Their results can be seen in Tables 3 and 4. Major Quality Indexes (causes) improved significantly in the group of Doctors in 4 cases, including the fourth case, which referred to a violent death with possible medical-legal repercussions. Table 4 presents the *minor or formal quality indexes*. The table shows that most indexes improve, that is, the use of abbreviations decreases and the use of capital letters rises. The introduction of several causes of death is only reduced significantly in case 4.

4. Discussion

The formative intervention was carried out to raise awareness and improve the professional competence regarding the new system of assessment of causes of death in death certificates in Spain in which, as a consequence of the new changes, practitioners only fill in one document instead of two documents (death certificate and statistical report of death) and, above all, to further improve the quality of mortality statistics. The innovative aspect of this formative experience is the fact that it uses new technologies to make learning and training easier with a blended learning model.

Good results were obtained in most of the cases through the *major and minor indexes* that were used. The most positive aspect was the series of significant and favorable changes, both individually and in the group as a whole, of students of Medicine in their last year and Family Doctors and Interns. In this last group, improvements were observed even in the most difficult cases (cases 4 and 5, violent or natural death and a chronic pluripathological patient),

Table 1Major indexes related to the certification of causes of death: assessment of *underlying*, *intermediate* and *immediate* cause by students in their last year of the Degree of Medicine.

Cases	Items	Pre-test		Post-test		<i>p</i> <i>p</i> < 0.05
		Frequency	%±95%CI	Frequency	%±95%CI	
1	Underlying cause	266	86.4 ± 0.04	303	98.4 ± 0.01	0.002
	Intermediate cause	215	68.8 ± 0.05	248	80.5 ± 0.04	0.000
	Immediate cause	304	98.7 ± 0.01	305	99.0 ± 0.01	0.000
2	Underlying cause	287	93.2 ± 0.03	306	99.4 ± 0.01	0.000
	Intermediate cause	273	88.6 ± 0.04	288	93.5 ± 0.03	0.000
	Immediate cause	306	99.4 ± 0.01	306	99.4 ± 0.01	0.954
3	Underlying cause	282	91.6 ± 0.03	304	98.7 ± 0.01	0.002
	Intermediate cause	239	77.6 ± 0.05	281	91.2 ± 0.03	0.000
	Immediate cause	308	100	308	100	
4	Underlying cause	180	58.4 ± 0.06	200	64.9 ± 0.05	0.136
	Intermediate cause	85	27.6 ± 0.05	97	31.5 ± 0.05	0.000
	Immediate cause	205	66.6 ± 0.05	204	66.2 ± 0.05	0.888
5	Underlying cause	290	94.2 ± 0.03	306	99.4 ± 0.01	0.808
	Intermediate cause	260	84.4 ± 0.04	268	87.0 ± 0.04	0.000
	Immediate cause	306	99.4 ± 0.01	306	99.4 ± 0.01	0.954

compared with the group of students, in which the results on these cases also improved, although without statistical significance.

The results prove the effectiveness of the formative intervention to improve the process of certification, which was the objective of this study and other studies that have recently and previously been carried out by other researchers.^{9,16}

The specific focus of our study on students and Primary Care doctors is justified by the fact that more errors have been described in the community health environment than the hospital environment.^{17,18} The causes of these errors are the lower possibilities of diagnosis and poorer access to data and information on the clinical history of the deceased, although these factors may be changing thanks to the digitalization of Clinical Histories and the use of ICTs that make it possible to share clinical information between Primary Care and Hospital Care.

On the other hand, the results improved the previous experience that had been carried out with the same indexes and the same

basic process of teaching-learning, a seminar-workshop, which has been taught for years and which we have published in order to spread our formative experience,^{4,9,15} and which has been continued in the Faculty of Medicine and as part of our Continuing Training Program after the implementation of the new certification.^{19,20} This improvement in the process of certification is probably due to several reasons: larger teaching experience of the lecturers, the introduction of a forensic scientist to explain the medical and legal aspects and the higher emphasis on the validity of external causes and the possibility of on-line training. The greatest difficulty when making a decision currently lies on the question of whether the certification should be filled in by the doctor who checked the death or if there are doubts on the type of death (natural or violent) and of whether the certification should or should not be issued. This last option would give the opportunity to the Justice Administration to determine the initial cause of death effectively and validly.²¹ These are aspects on which, according to

Table 2Minor indexes related to the certification of causes of death: existence of many cases under *Underlying* cause, mechanisms of death instead of causes, inappropriate and vague terms, abbreviations and capital letters by students in their last year of the Degree of Medicine.

Cases	Items	Pre-test		Post-test		<i>p</i> <i>p</i> < 0.05
		Frequency	%±95%CI	Frequency	%±95%CI	
1	Mechanisms	44	19.0 ± 0.04	16	6.9 ± 0.03	0.000
	Inappropriate terms	99	39.0 ± 0.05	24	10.4 ± 0.03	0.000
	Abbreviations	82	35.5 ± 0.05	26	11.3 ± 0.04	0.000
	Several causes	6	1.9 ± 0.02	7	2.3 ± 0.02	0.000
	Capital letters	136	44.2 ± 0.06	295	95.8 ± 0.02	0.002
2	Mechanisms	17	7.4 ± 0.03	7	3.0 ± 0.02	0.007
	Inappropriate terms	38	16.5 ± 0.04	8	3.5 ± 0.02	0.000
	Abbreviations	43	18.6 ± 0.04	11	4.8 ± 0.02	0.000
	Several causes	9	2.9 ± 0.02	5	1.6 ± 0.01	0.000
	Capital letters	139	45.1 ± 0.06	302	98.1 ± 0.02	0.025
3	Mechanisms	11	4.8 ± 0.02	3	1.3 ± 0.01	0.000
	Inappropriate terms	41	17.7 ± 0.04	8	3.5 ± 0.02	0.000
	Abbreviations	155	67.1 ± 0.05	39	16.9 ± 0.04	0.001
	Several causes	31	10.1 ± 0.03	14	4.5 ± 0.02	0.000
	Capital letters	135	43.8 ± 0.06	301	97.7 ± 0.02	0.111
4	Mechanisms	21	9.1 ± 0.03	4	1.7 ± 0.01	0.001
	Inappropriate terms	39	19.9 ± 0.04	9	3.9 ± 0.02	0.002
	Abbreviations	225	97.4 ± 0.02	168	72.7 ± 0.05	0.571
	Several causes	84	27.3 ± 0.05	45	14.6 ± 0.04	0.000
	Capital letters	136	44.2 ± 0.06	301	97.7 ± 0.02	0.027
5	Mechanisms	9	3.9 ± 0.02	2	0.9 ± 0.01	0.002
	Inappropriate terms	12	5.2 ± 0.02	7	3.0 ± 0.02	0.000
	Abbreviations	19	8.2 ± 0.03	6	2.6 ± 0.02	0.000
	Several causes	18	5.8 ± 0.03	10	3.2 ± 0.02	0.000
	Capital letters	140	45.5 ± 0.06	302	98.1 ± 0.02	0.024

Table 3Major indexes related to the certification of causes of death: assessment of *underlying, intermediate and immediate cause* by Family Doctors and Interns.

Cases	Items	Pre-test		Post-test		<i>p</i> <i>p</i> < 0.05
		Frequency	%±95%CI	Frequency	%±95%CI	
1	Underlying cause	54	87.1 ± 0.08	62	100	0.000
	Logical sequence	57	91.9 ± 0.03	62	100	0.026
	Immediate cause	62	100	62	100	–
2	Underlying cause	55	87.7 ± 0.08	62	100	0.001
	Logical sequence	59	95.2 ± 0.05	62	100	0.072
	Immediate cause	62	100	62	100	–
3	Underlying cause	58	93.5 ± 0.06	61	98.4 ± 0.03	0.025
	Logical sequence	60	96.8 ± 0.02	61	98.4 ± 0.03	0.854
	Immediate cause	62	100	62	100	–
4	Underlying cause	52	83.9 ± 0.09	62	100	0.000
	Logical sequence	54	87.1 ± 0.08	57	91.9 ± 0.03	0.050
	Immediate cause	59	95.2 ± 0.05	62	100	0.002
5	Underlying cause	59	95.2 ± 0.05	61	98.4 ± 0.03	0.091
	Logical sequence	61	98.4 ± 0.03	61	98.4 ± 0.03	–
	Immediate cause	61	98.4 ± 0.03	61	98.4 ± 0.03	–

the experts of the Judicial Institutions, more emphasis has to be made, and which can significantly contribute to improve the quality of statistics and Public Health.²²

Also, these individual and group improvements can be due to a higher availability of formative material on the on-line platform *Studium* of the University of Salamanca, which has made it possible for the students to review, revise and self-assess the knowledge that they acquired with additional materials¹ and to train with the 12 cases that were studied and analyzed in the seminar-workshop, which were available for a few weeks. From our point of view, on-line training facilitates *self-learning* or *self-education*, and that strategy has been developed and implemented in Spain through the CERTIFICA program, which was created and edited in 2004 by the Spanish Ministry of Health with the objective to promote *self-education* for doctors in the Spanish Health System.²³

The results were not so positive in the group of students with cases 4 and 5, probably due to their higher difficulty, given the fact that it was a case with a problematic sequence and clinical history

in which the certifying student/practitioner had to decide whether the fall that started the morbid events was induced by an *external cause*, in which the medical-legal intervention is necessary and the certification must not be issued, or a *natural cause* (osteoporosis), which does not have consequences and can be certified. This case tested one of the priority objectives information on the certification of the basic cause of death: being able to identify the cause and determine which professional must issue the certification, either the practitioner who has been assigned the case, if it is a death by natural causes (disease), or a forensic scientist, if the death was due to an external cause with medical-legal repercussions, in which case the first practitioner must not issue the certificate and a legal process must be initiated by going to court.^{21,22} The results that were observed may be limited by the selection of cases, which was based on 12 common cases in which there were medical-legal difficulties. This may account for the fact that there was an improvement among the students, but with no statistical significance, particularly in cases 4 and 5.

Table 4Minor indexes related to the certification of causes of death: existence of many cases under *Underlying cause*, mechanisms of death instead of causes, inappropriate and vague terms, abbreviations and capital letters by Family Doctors and Interns.

Cases	Items	Pre-test		Post-test		<i>p</i> <i>p</i> < 0.05
		Frequency	%±95%CI	Frequency	%±95%CI	
1	Mechanisms	2	3.2 ± 0.04	0	–	–
	Inappropriate terms	0	–	0	–	–
	Abbreviations	30	48.4 ± 0.12	23	37.1 ± 0.12	0.000
	Several causes	0	–	0	–	–
	Capital letters	44	71.0 ± 0.11	49	79.0 ± 0.10	0.000
2	Mechanisms	1	1.6 ± 0.03	0	–	–
	Inappropriate terms	0	–	0	–	–
	Abbreviations	23	37.1 ± 0.12	18	29.0 ± 0.11	0.000
	Several causes	2	3.2 ± 0.04	1	1.6 ± 0.03	0.854
	Capital letters	35	56.5 ± 0.12	46	74.2 ± 0.11	0.000
3	Mechanisms	0	–	0	–	–
	Inappropriate terms	0	–	0	–	–
	Abbreviations	50	80.6 ± 0.10	30	48.4 ± 0.12	0.014
	Several causes	5	8.1 ± 0.07	3	4.8 ± 0.05	0.099
	Capital letters	31	50.0 ± 0.12	46	74.2 ± 0.11	0.000
4	Mechanisms	1	1.6 ± 0.03	1	1.6 ± 0.03	0.000
	Inappropriate terms	0	–	0	–	–
	Abbreviations	61	98.4 ± 0.03	57	91.9 ± 0.07	0.765
	Several causes	16	25.8 ± 0.11	11	17.7 ± 0.10	0.016
	Capital letters	33	53.2 ± 0.12	49	79.0 ± 0.10	0.000
5	Mechanisms	0	–	0	–	–
	Inappropriate terms	0	–	0	–	–
	Abbreviations	59	95.2 ± 0.05	56	90.3 ± 0.07	0.667
	Several causes	2	3.2 ± 0.04	1	1.6 ± 0.03	0.000
	Capital letters	36	58.1 ± 0.12	51	82.3 ± 0.10	0.000

On the other hand, most of the students offered a positive assessment of this blended learning mode of formation with on-site and on-line training. It was described as «interesting» by 237 students (77%) and «very interesting» by 34 students (11%). The contents and process were considered adequate by 274 students (89%). The results were similar to what had been registered in previous experiences.¹⁰ As could be expected, the comments made by the subjects of the intervention, and particularly the group of students, ask for more initiatives of blended learning formation.

5. Conclusions

Interventions in the process of teaching-learning, both with classic on-site models and with blended learning models complemented with ICTs, must be effective in the improvement of professional competences related with the certification of death. This experience, based on the introduction of a blended learning model of training, has been both positive and effective.

The results will improve the quality of certifications²⁴ and the use of death-based indexes, such as the Spanish National Index of Deaths,²⁵ which will, in turn, promote basic biomedical research and/or clinical or applied research on Public Health, such as the assessment of health prevention and/or attention in the different Health Systems. It will also be useful to assess the *multicausality* of diseases, because its study is not possible with the current model of certification, unless all the morbid or pathological processes associated or related with the underlying or basic cause are taken into account and assessed in the section of *Other Processes*.^{19,20}

Consequently, ICT must be introduced as an innovation in Higher Education and Continuing Professional Development, because this experience, which is based on the introduction of *on-line training* systems, has been positive and effective, which will in turn lead to an improvement in the quality of mortality statistics. Further studies must assess whether there are differences among on-site and on-line teaching-learning systems through the ICT on which the self-learning section of the CERTIFICA program is based (Spanish National Health System/Ministry of Health). Also, these studies must compare this last system with the learning systems based on teachers and expert professionals who participate in on-site or blended learning programs.

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